

AN ANNOTATED BIBLIOGRAPHY FOR  
DISTRIBUTED RC NETWORKS

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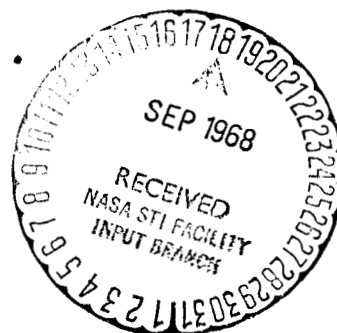
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Abstract: This bibliography contains a listing of the references to distributed RC networks published from 1958 to mid 1968. A short summary is given describing each of the references.

September 1968



## INTRODUCTION

This bibliography contains a listing, arranged in alphabetical order, of the papers which have appeared in the electrical engineering literature pertinent to the subject of distributed RC networks. In general, reports which are not readily available, or which contain material similar to that presented in well-known journals, have not been listed. An exception has been made in the case of a few widely referenced papers. A short summary of the content of each paper follows the bibliographic data.

A listing of the journals searched follows:

IEEE Transactions on Circuit Theory, vol. CT-5 (1953) to vol. CT-15 (June 1968).

IEEE International Convention Record, vol. 6 (1958) to vol. 15 (1967).

IEEE International Convention Record (Circuit Theory), vol. 6 (1958) to vol. 15 (1967).

IEEE Proceedings, vol. 46 (1958) to vol. 56 (May 1968).

Proceedings of the National Electronics Conference, vol. 14 (1958) to vol. 23 (1967).

Proceedings of the Allerton Conference on Circuit and System Theory, 1st (1963) to 5th (1967).

Proceedings of the Midwest Symposium on Circuit Theory, 6th (1963) to 10th (1967).

Electronics Letters, vol. 1 (March 1963) to vol. 4 (May 17, 1968).

Proceedings of the First Asilomar Conference on Circuits and Systems, (1967).

In addition to the papers listed in the bibliography, there are currently available two books which contain a significant amount of material concerning distributed circuits. These are:

CHIRLIAN, P. M. Integrated and Active Network Analysis and Synthesis, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1967.

GHAUSI, M. S., J. J. Kelly. Introduction to Distributed-Parameter Networks, Holt, Rinehart and Winston, Inc., New York, 1968.

## BIBLIOGRAPHY

- BARKER, D. G. "Synthesis of Active Filters Employing Thin Film Distributed Parameter Networks," IEEE International Convention Record, Part 7, pp. 119-126, Mar. 1965, vol. 13.

Filter synthesis using Heizer's technique (1963) to obtain networks with rational transfer functions is presented.

- BERGER, H. "Generalized Non-Uniform Transmission Lines," IEEE Trans. on Circuit Theory, vol. CT-13, pp. 92-93, Mar. 1966.

A procedure for generalizing non-uniform transmission line problems which includes the generalized exponential and bessel lines as special cases is discussed.

- BERTINOLLI, E.C., C. A. Halijak. "Distributed Parameter RC Network Analysis," IEEE International Convention Record, Part 7, pp. 243-249, Mar. 1966.

Transmission parameters of an arbitrarily tapered RC line are obtained by multiplication of transmission matrices of small sections of the line.

- BERTINOLLI, E. C. "Analysis of the n-Wire Exponential Line," Proc. of IEEE, vol. 55, p. 1225, July 1967.

An approach that provides the distributed network's transfer matrix in a form useful for both transient and steady state calculations is used to analyze the n-wire exponential line.

- BHATTACHARYYA, B. B., J. G. Giguere, M. N. S. Swamy. "Driving Point Function Synthesis Using Uniform Transmission Lines," Proc. of IEEE, vol. 56, pp. 868-869, May 1968.

It is shown that the two classes of driving point functions realized by Wyndrum (1963) and by O'Shea (1965), using uniform transmission lines, are identical and further that these driving point functions may always be cascade synthesized. An alternative set of necessary and sufficient conditions for this class of driving point functions is given.

- BHATTACHARYYA, B. B., M. N. S. Swamy. "Interrelationships Among the Chain Matrix Parameters of a Non-Uniform Transmission Line," Proc. of IEEE, vol. 55, pp. 1763-1764, Oct. 1967.

It is shown that the chain matrix parameters of a non-uniform transmission line are related, and that knowing any one of them, the other three may be determined.

- BHATTACHARYYA, B. B., M. N. S. Swamy, V. Ramachandran. "Representation of Non-Uniform Hyperbolic Class of RCG-Lines by Uniform Lines," Proc. of NEC, vol. 23, pp. 194-198, Oct. 1967.

For a general class of non-uniform RCG lines with hyperbolic solutions, the Y and Z parameters have been expressed in terms of those of a uniform RCG line.

BOURQUIN, J. J., T. N. Trick. "Stability of Distributed RC Networks," Tenth Midwest Symposium on Circuit Theory, Conference Record, Paper XII-2, May 1967.

Stability criteria are presented for linear, time-invariant networks with uniform RC lines included.

BRAUN, J., M. Novak. "Active Distributed RC Network," Electronics Letters, vol. 3, pp. 435-436, Sept. 1967.

A new type of active network is introduced, combining field effect properties with a distributed RC network. The analysis of the admittance matrix is carried out, and the location of the dominant poles and zeros is discussed.

BROWN, F. "Flow Graphs and Tapered Transmission Lines," Proc. of IRE, vol. 49, pp. 1696, Nov. 1961.

Flow graph theory is applied to the analysis of non-uniform RC lines.

CASTRO, P. S. "RC distributed Parameter Network with Circular Geometry," Proc. of NEC, vol. 19, pp. 98-106, Oct. 1963.

The indefinite admittance matrix of the R-C-nR, distributed four terminal network with circular geometry is derived.

CASTRO, P. S., W. W. Happ. "Distributed Parameter Circuits and Microsystem Electronics," Proc. of NEC, vol. 16, pp. 448-460, Oct. 1960.

The indefinite admittance matrix of the uniform distributed four terminal R-C-NR network is derived.

CHANG, F. Y., O. Wing. "Uniform Multi-Layer RC Distributed Networks," Proc. of Fifth Annual Allerton Conf., pp. 290-299, Oct. 1967.

The canonical forms of the network functions of a multi-layer RC distributed network are obtained and expressed in terms of the eigenvalues of a certain "time-constant matrix". The voltage transfer function is found to have a low, high, or band-pass characteristic with an absolute value possibly greater than unity over a range of frequencies.

COMPTON, J. B., W. W. Happ. "A Practical Distributed Parameter Active Filter," Proc. of Eighth Midwest Symposium on Circuit Theory, Fort Collins, Colorado, pp. 29-0 to 29-20.

The selectivity of several types of distributed parameter null networks is determined for null and off null conditions.

CULVER, H. E., C. E. Gane. "Active Distributed-Parameter Thin Film Networks," Proc. IEEE, vol. 51, pp. 1034-1035, July 1963.

The use of an active (semiconductor) resistive film for frequency modulation of phase shift oscillators using RC lines is discussed.

DICKER, D. "Analysis of Distributed Parameter Networks - A General Method," Proc. of Third Annual Allerton Conf., pp. 144-150, Oct. 1965.

A very technical mathematical analysis of distributed networks using the Bubnov-Galerkin method is presented.

DUTTA ROY, S. C. "On Some Three-Terminal Lumped and Distributed RC Null Networks," IEEE Trans. on Circuit Theory, vol. CT-11, pp. 98-103, Mar. 1964.

A detailed comparison of various lumped three terminal null networks with their tapered distributed counterparts is given.

DUTTA ROY, S. C. "Notch Networks Using Distributed RC Elements," Proc. of IEEE, vol. 54, pp. 1220-1221, Sept. 1966.

Notch networks of various types are discussed with special attention being given to figure of merit.

DUTTA ROY, S. C., B. A. Shenoi. "Transient and Frequency Response of the Distributed RGC Network," Electronics Letters, vol. 2, pp. 60-61, Feb. 1966.

Characteristics of an RC line with dielectric leakage, are presented.

DUTTA ROY, S. C. "Discussion of 'Tapered Distributed RC Lines for Phase Shift Oscillators'", Proc. of IRE, vol. 50, pp. 482-483, Apr. 1962.

See: W. A. Edson, "Tapered Distributed RC Lines for Phase Shift Oscillators," Proc. of IRE, vol. 49, pp. 1021-1024, June 1961.

EDSON, W. A. "Tapered Distributed RC Lines for Phase Shift Oscillators," Proc. of IRE, vol. 49, pp. 1021-1024, June 1961.

Design of Oscillators using exponentially tapered RC lines is discussed.

Note: See comment by S. C. Dutta Roy, Proc. of IRE, vol. 50, pp. 482-483, Apr. 1962.

EKSTROM, J. L. "The Z Matrix Parameters of Tapered Transmission Lines," IRE on Trans. on Circuit Theory, vol. CT-9, pp. 132-135, June 1962.

An improved method of computing the Z parameters of 2-port tapered transmission lines is presented. As an example the Z parameters for the "Generalized Transmission Line" are found.

EKSTROM, J. L. "On the Transfer Impedances of Non-Uniform Transmission Lines," IRE Trans. on Circuit Theory, vol. PGCT-8, p. 360, Sept. 1961.

Transfer impedance calculation from knowledge of input impedance under various load conditions is illustrated.

FU, Y., J. S. Fu. "N-Port Rectangular-Shaped Distributed RC Networks," IEEE Trans. on Circuit Theory, vol. CT-13, pp. 222-225, June 1966.

Extending the work of Heizer (1963) to the n-port case, a rectangular structure is developed as an n-port with rational short circuit admittances.

FU, Y., J. S. Fu. "Synthesis of Active Distributed RC Networks," IEEE Trans. on Circuit Theory, vol. CT-13, pp. 259-264, Sept. 1966.

A general method of synthesis of any rational open circuit transfer function using two distributed RC networks, NIC, and a lumped capacitor is presented.

GAY, M. J. "Selectivity of Notch Filters Using Non-Uniform RC Lines," Electronics Letters, vol. 1, pp. 293, Dec. 1965.

A definition of selectivity for distributed notch filters is given.

GHAUSI, M. S., G. J. Herskowitz. "The Transient Response of Tapered Distributed RC Networks," IEEE Trans. on Circuit Theory, vol. CT-10, pp. 443-445, Sept. 1963.

A method is presented whereby the delay and rise times for arbitrarily tapered distributed networks may be calculated.

GHAUSI, M. S., G. J. Herskowitz. "The Effect of Shaping and Loading on Distributed RC Networks," Journal of the Franklin Institute, vol. 278, pp. 108-123, Aug. 1964.

The effects of network shaping and loading on the transient and frequency response of distributed RC networks are examined analytically and experimentally.

GIGUERE, J. C., M. N. S. Swamy, B. B. Bhattacharyya. "Driving Point Immittance Synthesis Using Exponential Lines," Proc. of Fifth Annual Allerton Conf., pp. 263-267, Oct. 1967.

Synthesis of irrational driving point immittances using exponential RC lines is presented.

GIGUERE, J. C., M. N. S. Swamy, B. B. Bhattacharyya. "Driving Point Function Synthesis Using Tapered RC Lines and Their Duals," Proc. of the First Asilomar Conference on Circuits and Systems, pp. 309-317, Nov. 1967.

Composite lines composed of various types of non-uniform lines connected in cascade are used to synthesize certain classes of irrational functions as driving point functions.

GOUGE, J. M., K. L. Su. "The Double-Kelvin Transmission Line and Some Applications," IEEE Trans. on Circuit Theory, vol. CT-11, pp. 372-377, Sept. 1964.

A new type of RC distributed line, with two resistive layers, is introduced. The Z matrix of the line is derived, and application as a notch filter is considered.

GOUGH, K. J. "Tapered RC Networks with Rational Admittances," IEEE Trans. on Circuit Theory, vol. CT-15, pp. 81-87, Mar. 1968.

It is shown that if the capacitance of any distributed RC network is suitably divided between two or more conductors rational admittances are obtained. The possible pole positions of the rational transfer functions are shown to be the zeros of the driving point impedance of the prototype network from which the divided conductor is derived.

GOUGH, K. J., R. N. Gould. "Non-Uniform RC and Lossless Transmission Lines," IEEE Trans. on Circuit Theory, vol. CT-13, pp. 453-454, Dec. 1965.

A new method is presented for finding all RC lines which have exactly solvable differential equations.

GRUNER, L. "The Steady-State Characteristics of Non-Uniform RC Distributed Networks and Lossless Lines," IEEE Trans. on Circuit Theory, vol. CT-12, pp. 241-247, June 1965.

Two auxiliary functions are introduced to compare the steady-state characteristics of various non-uniform RC distributed networks.

GRUNER, L. "Lumped Parameter Analogues of Non-Uniform RC Distributed Networks and Lossless Transmission Lines," Electronics Letters, vol. 2, pp. 58-59, Feb. 1966.

Analogues of RC lines are deduced, and their chain parameters are expressed in terms of the solutions of the associated difference equations.

GRUNER, L. "Two port Parameters of Non-Uniform Distributed Structures and Their Asymptotic Properties," IEEE Trans. on Circuit Theory, vol. CT-14, pp. 420-422, Dec. 1967.

An application of the Youla technique (IEEE Trans. on Circuit Theory, Sept. 1964) is used to obtain expressions for the 2-port parameters of non-uniform lines suitable for numerical integration as well as low and high frequency approximations.

HAPP, W. W. "Synthesis of Distributed Parameter RC Networks," Proc. of IRE, vol. 50, pp. 483-484, Apr. 1962.

Various possibilities of synthesis using network shaping are investigated.

HAPP, W. W., S. C. Gupta. "Reciprocal Time Domain Analysis of Distributed Networks," Proc. of Fourth Annual Allerton Conf., pp. 849-857, Oct. 1966.

It is shown that for RC structures the impulse response results in a spectrum of poisson derived functions in the reciprocal time domain. The technique is used to investigate transient response of distributed networks.

HAPP, W. W., F. A. Lindholm. "Design Charts for the Transient Response of R-C Distributed-Parameter Networks," Proc. of First Annual Allerton Conf., pp. 171-190, Nov. 1963.

Design charts for RC distributed networks based upon desired transient response are constructed by using a lumped model for the network.

HEIZER, K. W. "Distributed RC Networks with Rational Transfer Functions," IRE Trans. on Circuit Theory, vol. CT-9, pp. 356-362, Dec. 1962.

Construction of distributed RC lines to have a rational short circuit transfer admittance and one rational short circuit driving point admittance is presented.

HEIZER, K. W. "Rational Parameters with Distributed Networks," IEEE, Trans. on Circuit Theory, vol. CT-10, pp. 531-532, Dec. 1963.

A modification of Heizer's earlier structure to increase flexibility is introduced.

HELLSTROM, M. J., J. Pearl. "Comments on 'Symmetrical RC Distributed Networks,'" Proc. of IRE, vol. 50, pp. 2130-2131.

See: M. J. Hellstrom, "Symmetrical RC Distributed Networks," Proc. of IRE, vol. 50, pp. 97-98, Jan. 1962.

HELLSTROM, M. J. "A New Class of Distributed RC Ladder Networks," Proc. of IRE, vol. 50, pp. 1989-1990, Sept. 1962.

Introduction of a "Generalized Hyperbolic Class" of lines, of which the "Generalized Exponential Class" is a subcategory.

HELLSTROM, M. J. "Symmetrical RC Distributed Networks," Proc. of IRE, vol. 50, pp. 97-98, Jan. 1962.

It is shown that it is necessary and sufficient that incremental resistance be proportional to incremental capacitance to have a symmetrical network.

HELLSTROM, M. J. "Equivalent Distributed RC Networks or Transmission Lines," IRE Trans. on Circuit Theory, vol. CT-9, pp. 247-251, Sept. 1962.

A method is presented to calculate equivalent distributed RC networks all of which provide the same electrical performance.

JACOBS, I. "A Generalization of the Exponential Transmission Line," Proc. of IRE, vol. 47, pp. 97-98, Jan. 1959.

The exponential line is presented as a special case of a general class of exponential line characterized by series impedance per unit length  $Z(x)$  and shunt admittance per unit length  $Y(x)$ .

The general exponential line is defined by

$$\frac{1}{r(x)} \frac{\partial \ln K(x)}{\partial x} = C$$

$$\text{where } K(x) = \sqrt{Z(x)/Y(x)}, \quad r(x) = \sqrt{Z(x)Y(x)}$$

KARNIK, A. R., G. H. Cohen. "Optimal Design of Distributed Parameter Systems," Proc. of 10th Midwest Symposium on Circuit Theory, Paper II-2, pp. 1-9, May 1967.

A method of optimal design of distributed RC lines using variational calculus is introduced. The method of solution is based upon the gradient technique.

KAUFMAN, W. M. "Theory of a Monolithic Null Device and Some Novel Circuits," Proc. of IRE, vol. 48, pp. 1540-1545, Sept. 1960.

The RC distributed network is introduced as an effective null device. Analysis is made using a lumped equivalent model, and examples are given. Comparison is made between a distributed bridged-T and a lumped element equivalent.

KAUFMAN, W. M., S. J. Garrett. "Tapered Distributed Filters," IRE Trans. on Circuit Theory, vol. CT-9, pp. 329-336, Dec. 1962.

The characteristics of uniform, exponentially tapered, and linearly tapered distributed networks used as notch filters are extensively investigated.



KELLY, J. J., M. S. Ghausi. "On the Effective Dominant Pole of the Distributed RC Networks," Journal of the Franklin Institute, vol. 279, pp. 417-429, June 1965.

The concept of the effective dominant pole of a distributed RC network is developed. Key features of the steady-state and transient response such as bandwidth, rise time, and time delay may be closely approximated with minimal effort.

KELLY, J. J., M. S. Ghausi. "Tapered Distributed RC Networks with Similar Immitances," IEEE Trans. on Circuit Theory, vol. CT-12, pp. 554-558, Dec. 1965.

It is shown that the uniform, exponential, hyperbolic, trigonometric and square tapered lines are members of the same class of network, with short circuit admittance parameters given by a single set of equations.

KELLY, J. J., M. S. Ghausi. "Steady-State and Transient Response of Arbitrarily Tapered Distributed RC Networks with Lumped Load Terminations," Proc. of NEC, vol. 21, pp. 125-130, Oct. 1965.

A simple approximation is used to obtain expressions for the 3DB frequency, rise time and delay time of arbitrarily tapered distributed RC networks.

KERWIN, W. J. "Synthesis of Active RC Networks Containing Distributed and Lumped Elements," Proc. of the First Asilomar Conference on Circuits and Systems, pp. 288-298, Nov. 1967.

A practical procedure for synthesizing distributed, lumped active (DLA) networks is developed by determining a set of equivalent rational pole positions corresponding to the amplitude response of three specific DLA networks which together allow the realization of filters with left half plane poles and  $j\omega$  axis zeros. An example of the synthesis of a 5-pole, 4  $j\omega$  axis zero elliptic function low-pass filter is given.

KLEINHEINS, S. "Contribution to the Synthesis of Distributed RC Networks," Electronics Letters, vol. 3, pp. 465-566, Oct. 1967.

On using a special frequency transformation, a theorem on the synthesis of uniformly distributed RC networks is derived. A network section is introduced which extends the range of realizability of transfer zeros.

KLEINHEINS, S. "Steepness of a Loaded Exponentially Tapered Distributed RC Notch Filter," Electronics Letters, vol. 2, pp. 374-375, Oct. 1966.

An exponential line filter is shown to have maximum notch steepness for a finite degree of taper when loaded by a source and load resistor.

KLEINHEINS, S. "Steepness of an Exponentially Tapered Distributed RC Notch Filter," Electronics Letters, vol. 2, pp. 262-263, July 1966.

It is shown that the notch steepness of the open-circuit voltage transfer function of an exponential line filter approaches a finite value as the taper degree approaches infinity.

KRYKORKA, P. "Optimization of the Cascade Synthesis of Distributed RC Networks," Electronics Letters, vol. 4, pp. 69-70, Feb. 1968.

A modification of Wyndrum's method (1963) to minimize the ratio of maximum to minimum capacitance or resistance of individual cascade sections is introduced.

KURSS, H., W. K. Kahn. "A System of Non-Uniform Transmission Lines," Proc. of IRE, vol. 48, pp. 250, Jan. 1960.

The n-port generalization of a single transmission line is given.

LINDGREN, A. G. "Transfer Characteristics of a Class of Distributed RC Networks," Proc. of IEEE, vol. 53, pp. 625-626, June 1965.

Transfer characteristics of the trigonometric, parabolic, and hyperbolic lines as a generalization of the characteristics of the exponential line are investigated.

LINDHOLM, F. A., W. W. Happ. "Analysis of Transients in R-C Distributed Parameter Networks," Proc. of First Annual Allerton Conf., pp. 148-170, Nov. 1963.

A lumped model is used to determine transient behavior. The model is justified in detail.

MANOLESCU, A. "Single Transistor Oscillators with Distributed RC Networks," Electronics Letters, vol. 2, pp. 151-152, Apr. 1966.

Three single transistor oscillators with uniform distributed RC networks are presented.

NAGUMO, J., S. Yoshizawa, S. Arimoto. "Bistable Transmission Lines," IEEE Trans. on Circuit Theory, vol. CT-12, pp. 400-412, Sept. 1965.

The characteristics of a distributed RC-tunnel diode line are analyzed in detail.

OEHLER, K. L., W. C. Dueterhoeft, Jr. "A Graphical Design for Exponentially Tapered RC Circuits," IEEE Trans. on Circuit Theory, vol. CT-12, pp. 288-290, June 1965.

The geometrical shape for an exponentially tapered RC line taking two dimensional current flow into account is given.

O'SHEA, R. P. "Synthesis of Driving Point and Transfer Functions Using Distributed RC Networks," IEEE Trans. on Circuit Theory, vol. CT-12, pp. 546-554, Dec. 1965.

Synthesis of driving point and transfer functions using uniform distributed RC networks is presented. The transformation  $P = \cosh \sqrt{s}RC$  is used.

O'SHEA, R. P. "Synthesis Using Distributed RC Networks," IEEE International Convention Record, Part 7, pp. 18-29, Mar. 1965.

Driving point and transfer function synthesis using uniform RC lines as elements of lumped networks is developed. Use is made of the transformation  $P = \cosh \sqrt{s}RC$ .

PARKIN, R. E. "Approximations to the Equations Describing Distributed RC Networks," IEEE Trans. on Circuit Theory, vol. CT-12, pp. 598-600, Dec. 1965.

A useful method to approximate the equations associated with the exponentially tapered line is illustrated.

PENBECCI, S. S., S. C. Lee. "A General Approximation Synthesis Method Using Uniform RC and RCG Lines," Proc. of Fifth Annual Allerton Conf., pp. 279-287, Oct. 1967.

Synthesis of irrational driving point and transfer immitances by using uniform RC and RCG networks as circuit elements is investigated.

PROTONOTARIOS, E. N., O. Wing. "Distribution of Zeros of ABCD Parameters of Arbitrary RC Transmission Lines," Proc. of Third Annual Allerton Conf., pp. 162-171, Oct. 1965.

Behavior of the zeros of the transmission parameters of the line is studied. The zeros are related to the eigenvalues of four properly formulated Sturm-Liouville problems.

PROTONOTARIOS, E. N., O. Wing. "Theory of Non-Uniform RC Lines Part I: Analytic Properties and Realizability Conditions in the Frequency Domain," IEEE Trans. on Circuit Theory, vol. CT-14, pp. 2-12, Mar. 1967.

An intrinsic description of the frequency domain response of a non-uniform RC line is presented. The network functions are expressed as ratios of entire functions. Analytic properties of these entire functions are studied. Their order, type, genus, and their asymptotic behavior and their bounds on the real frequency axis are determined. Necessary and sufficient conditions are given for a transcendental frequency function to be a network function of a non-uniform RC line.

PROTONOTARIOS, E. N., O. Wing. "Theory of Non-Uniform RC Lines Part II: Analytic Properties in the Time Domain," IEEE Trans. on Circuit Theory, vol. CT-14, pp. 2-12, Mar. 1967.

The time-domain behavior of the general non-uniform RC transmission line is presented. It is shown that the impulse response is a "totally positive" density function. The necessary and sufficient condition on a time function to be the impulse response of a non-uniform RC line is obtained. The general properties, including the bounds on the impulse response and its asymptotic behavior, are given.

PROTONOTARIOS, E. N., O. Wing. "Delay and Rise Time of Arbitrarily Tapered RC-Transmission Lines," IEEE International Convention Record, Part 7, pp. 1-6, Mar. 1965.

The transmission parameters of an arbitrarily tapered line are expressed as infinite series. The delay and rise time of the network are given in terms of these parameters. Examples are included.

PROTONOTARIOS, E. N., O. Wing. "Computation of the Step Response of a General Non-Uniform RC Distributed Network," IEEE Trans. on Circuit Theory, vol. CT-14, pp. 219-221, June 1967.

A method of calculation of step response based on the "Method of Moments" of Chebyshev is presented.

RAMACHANDRAN, V. "Network Representation of Exponential Transmission Lines," IRE Trans. on Circuit Theory, vol. CT-9, pp. 136-143, June 1962.

A representation of the exponential transmission line by networks comprised of lumped elements is given.

RAMACHANDRAN, V., K. K. Nair. "Equivalent Circuits of an Exponential Transmission Line," IRE Trans. on Circuit Theory, vol. CT-7, pp. 71-74, Mar. 1960.

The exponential line is divided into a number of sections, and the exact transmission parameters for a small section are derived, the transmission matrices of the sections are multiplied to find the transmission matrix of the line.

RAO, T. N., R. W. Newcomb. "Synthesis of Lumped-Distributed RC N-Ports," IEEE Trans. on Circuit Theory, vol. CT-13, pp. 458-459, Dec. 1966.

A method of synthesis is presented which utilizes lumped elements together with uniform RC networks.

RHODES, J. D. "Transfer Function Realizability of Grounded URC Networks," IEEE Trans. on Circuit Theory, vol. CT-14, pp. 219-239, June 1967.

Necessary and sufficient conditions for the realization of a short circuit transfer admittance by means of a grounded uniform RC distributed network are presented. The procedure used in testing for realizability and synthesis is demonstrated by a nontrivial worked example.

RHODES, J. D. "Cascade of Simple Commensurate Uniformly Distributed RC Four-Port Unit Elements," Electronics Letters, vol. 1, pp. 281-282, Dec. 1965.

The four-port transmission matrix for a constant CRC distributed element is presented. Wyndrum's (1963) hyperbolic complex frequency transformization is used.

ROHRER, R. A., J. A. Resh, R. A. Hoyt. "Distributed Network Synthesis for a Class of Integrated Circuits," IEEE International Convention Record, Part 7, pp. 100-112, Mar. 1965.

Distributed network synthesis using network optimization in both time and frequency domain is investigated. The calculus of variation is employed.

SCANLAN, J. O., J. D. Rhodes. "Realizability and Synthesis of a Restricted Class of Distributed RC Networks," IEEE Trans. on Circuit Theory, vol. CT-12, pp. 577-585, Dec. 1965.

Synthesis using uniform RC lines is presented. The transformation  $s \rightarrow \tanh \sqrt{RC}s$  is employed. A cascade connection of uniform RC networks is used.

SCANLAN, J. O., J. D. Rhodes. "Frequency Response of Distributed RC Networks," Electronics Letters, vol. 1, pp. 267-268, Nov. 1965.

Frequency response of distributed lines is investigated by using the transformation  $t = \tanh(RCs)^{1/2}$ .

SCOTT, A. C. "The Distributed Tunnel Diode Oscillator," IEEE Trans. on Circuit Theory, vol. CT-10, pp. 53-59, Mar. 1963.

The tunnel diode oscillator in which the negative conductance is distributed along a quarter wave transmission line is analyzed.

SHENOI, B. A. "Frequency Characteristics of a Double-Kelvin Transmission Line Network," Proc. of Third Annual Allerton Conf., pp. 151-161, Oct. 1965.

A bandpass filter characteristic is obtained by connecting a four layer RC distributed network in the feedback path of a high gain amplifier.

STEENART, W. J. D. "The Simulation of Coaxial Cable by a Distributed RC Homogeneous Transmission Line and the Approximate Realization of its  $Z_o$ ," IEEE Trans. on Circuit Theory, vol. CT-11, pp. 502-504, Dec. 1964.

An interesting application of RC distributed networks in transmission line design is illustrated.

SU, K. L. "Some Exactly Solvable Non-Uniform RC Lines," IEEE Trans. on Circuit Theory, vol. CT-12, pp. 141-142, Mar. 1965.

Additional types of lines which have exactly solvable differential equations are briefly presented.

SU, K. L. "Hyperbolic RC Transmission Lines," Electronics Letters, vol. 1, pp. 59-60, May 1965.

The 2-port Z parameters of the hyperbolic line are derived. The hyperbolic line is defined by

$$\begin{aligned} r &= r_o \operatorname{sech}^2 x \\ c &= c_o \cosh^2 x \end{aligned}$$

SU, K. L. "Selectivity of Notch Filters Using Non-Uniform RC Lines," Electronics Letters, vol. 1, pp. 205-206, Sept. 1965.

The selectivity of a notch filter is defined, and parameters of the exponential, trigonometric, and hyperbolic lines for different selectivities are given.

SU, K. L. "The Trigonometric RC Transmission Lines," IEEE International Convention Record, Part 2, pp. 43-55, Mar. 1963.

An exhaustive analysis of the distributed RC line where

$$\begin{aligned} r(x) &= r_o \csc^2 x \\ c(x) &= c_o \sin^2 x \end{aligned}$$

is presented.

The discussion includes applications as a notch filter, and experimental results.

SU, K. L. "Effect of Load Conductance on the Selectivity of Notch Filters," Electronics Letters, vol. 1, pp. 217-218, Oct. 1965.

It is shown that the hyperbolic notch filter selectivity is less sensitive to load fluctuation than with exponential or trigonometric lines.

SU, K. L. "Selectivity of Notch Filters Using Non-Uniform RC Lines," Electronics Letters, vol. 2, pp. 11-12, Jan. 1966.

Comments on the letter of M. J. Gay in Dec. 1965 Electronics Letters are given.

SU, K. L. "Analysis of the Trigonometric RC Line and Some Applications," IEEE Trans. on Circuit Theory, vol. CT-11, pp. 158-160, Mar. 1964.

The Z matrix for the trigonometric line is derived. Application as a notch filter is investigated, and a comparison is made with the exponentially tapered filter.

SU, K. L. "Matrix Parameters of Non-Uniform Transmission Lines," IEEE Trans. on Circuit Theory, vol. CT-12, pp. 142-143, Mar. 1965.

The relation between the Z parameters of a non-uniform line and its differential equation is presented.

SUEZAKI, T., S. Mori, T. Kumanoto. "The Transient Response of Pulse Signal Through a Linear Distributed RC Network," Proc. of IEEE, vol. 56, pp. 876-878, May 1968.

For a distributed RC network a system of linear equations is solved by reducing it to an ordinary differential equation by means of transformation of variables. The equation is solved for the particular boundary conditions

$$\begin{aligned} V(0,T) &= T^n \\ V(\infty,T) &= 0 \end{aligned}$$

so that a solution may be found to a power series approximation to a pulse signal input.

SUGAI, I. "D'Alembert's Method for Non-Uniform Transmission Lines," Proc. of IRE, vol. 49, pp. 823-824, Apr. 1961.

D'Alembert's method is applied to the differential equations of a non-uniform line.

SUGAI, I. "A New Exact Method of Non-Uniform Transmission Lines," Proc. of IRE, vol. 49, pp. 627-628, Mar. 1961.

Two new transforms are used to solve a generalized Riccati equation.

SUGAI, I. "Riccati's and Bernoulli's Equations for Non-Uniform Transmission Lines," IRE Trans. on Circuit Theory, vol. PGCT-8, pp. 359-360, Sept. 1961.

An analytical approach for exact solutions to non-uniform transmission lines by converting Riccati's equation to a Bernoulli equation is presented.

SWAMY, M. N. S., B. B. Bhattacharyya. "Generalized Non-Uniform Lines and Their Equivalent Circuits," Tenth Midwest Symposium on Circuit Theory, Conference Record, Paper II-4, May 1967.

It is shown that any line with proportional distributions may be transformed into an equivalent uniform line.

SWAMY, M. N. S., V. Rahachandran, B. B. Bhattacharyya. "Lumped Equivalent Circuits of an Exponential RC Line," Proc. of IEEE, vol. 55, p. 1531, Aug. 1967.

A LC-RC transformation is used to derive a lumped equivalent model for the RC line from the lumped model of the LC line.

UZUNOGLU, V. "A New Approach in the Design of Closed-Loop Active Networks with Distributed RC Elements," IEEE Trans. on Circuit Theory, vol. CT-13, pp. 100-101, Mar. 1966.

Feedback design techniques using the uniform distributed RC network are investigated.

VANDIVORT, C. A., E. C. Bertinolli. "Determining the Transfer Matrix of Tapered Multiwire Transmission Lines," Tenth Midwest Symposium on Circuit Theory, Conference Record, Paper II-5, May 1967.

A method is presented whereby a closed form solution in the laplace domain for an arbitrarily tapered  $2n$  terminal RC line may be obtained.

WILSON, B. L. H., R. B. Wilson. "Shaping of Distributed RC Networks," Proc. of IRE, vol. 49, pp. 1330-1331.

Phase shift with an exponentially tapered line is discussed.

WOO, B. B., J. M. Bartlemay. "Characteristics and Applications of a Tapered, Thin-Film Distributed Parameter Structure," IEEE International Convention Record, Part 2, pp. 43-55, Mar. 1963.

An analysis of the four terminal exponentially tapered network, with indefinite admittance matrix is presented. The paper includes applications as a filter and as a component an oscillator.

WOO, B. B., R. G. Hove. "Synthesis of Rational Transfer Functions with Thin Film Distributed-Parameter RC Active Networks," Proc. of NEC, vol. 21, pp. 241-246, Oct. 1965.

A method for synthesizing rational transfer functions with distributed networks and an INIC is presented. The method is compared with lumped element realizations.

WYNDRUM, R. W. "Distributed RC Notch Networks," Proc. of IEEE, vol. 51, pp. 374-375, Feb. 1963.

Null network tuning is discussed and normalized design curves are given.

WYNDRUM, R. W., Jr. "The Exact Synthesis of Distributed RC Networks," Technical Report 400-76, College of Engineering, New York University, Air Force Cambridge Research Laboratories Contract AF19(628)-379, May 1963.

The analysis and synthesis of distributed RC networks is treated on the basis of various P-R transformations, thus making it possible to synthesize in terms of lumped LC networks and rational functions and to transform this information into distributed RC specifications.

WYNDRUM, R. W. "Distributed RC Driving Point Functions," IEEE Trans. on Circuit Theory, vol. CT-15, pp. 160-162, June 1968.

Four theorems concerning driving point impedances of uniform RC networks are given. The Schlicht nature of the driving point functions is considered to derive more information concerning their character.

YOSHIZAWA, S., J. Nagumo. "A Bistable Distributed Line," Proc. of IEEE, vol. 52, p. 308, Mar. 1964.

Realization of a bistable line by cascading bistable circuits and the use of the line for waveform shaping is discussed.